IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re the Application of: **Jun TAKADA et al.** Art Unit: **1793**

Application Number: **10/509,156** Examiner: **Weiping Zhu**

Filed: **November 1, 2005** Confirmation Number: **5033**

For: **NITRIDED MO ALLOY WORKED MATERIAL HAVING HIGH CORROSION RESISTANCE, HIGH STRENGTH AND HIGH TOUGHNESS AND METHOD FOR PRODUCTION THEREOF**

Attorney Docket Number: **042724**
Customer Number: **38834**

SUBMISSION OF APPEAL BRIEF

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October 23, 2009

Sir:

Applicants submit herewith an Appeal Brief in the above-identified U.S. patent application.

Attached please find our payment in the amount of $540.00 to cover the cost for the Appeal Brief. If any additional fees are due in connection with this submission, please charge Deposit Account No. 50-2866.

Respectfully submitted,

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APPEAL BRIEF FOR THE APPELLANT

Ex parte **Jun TAKADA et al.** (Applicants)

NITRIDED MO ALLOY WORKED MATERIAL HAVING HIGH CORROSION RESISTANCE, HIGH STRENGTH AND HIGH TOUGHNESS AND METHOD FOR PRODUCTION THEREOF

Application Number: **10/509,156**

Filed: **November 1, 2005**

Appeal No.:

Art Unit: **1793**

Examiner: **Weiping Zhu**

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BRIEF ON APPEAL

(I) REAL PARTY IN INTEREST

The real party in interest is **Okayama University** and **A.L.M.T. Corp.**, by an assignment recorded in the U. S. Patent and Trademark Office on **March 4, 2009**, at Reel **022344**, Frame **0326**.

(II) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to appellant, appellants' legal representative, or assignee that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(III) STATUS OF CLAIMS

Claims 1 and 5-7 are pending in the application and claims 5 and 6 are withdrawn from consideration by the Examiner. Claims 1 and 7 are rejected and all the rejected claims are appealed. Claims 2-4 have been cancelled. The appealed claims appear in the Claims Appendix.

(IV) STATUS OF AMENDMENTS

No amendments have been filed subsequent to the close of prosecution.

(V) SUMMARY OF THE INVENTION

The present invention relates to a worked molybdenum-alloy material, which is subjected to nitriding, having improved strength, toughness, and corrosion resistance as a result of a combination treatment of internal nitriding and external nitriding (Specification page 1, lines 9-14).

Cold-worked metal materials are classified into three categories: (1) worked materials maintaining cold-worked structure; (2) recrystallized materials with reoriented crystal structure without strain; (3) recovered materials where strain in the deformed grains is reduced without recrystallization. The present invention is related to a two-staged nitrization of the worked materials. The surface area of treated materials still maintains the worked structure or the recovered structure.

Although molybdenum has excellent properties, molybdenum has poor corrosion resistance against oxidizing acids such as nitric acid and hot concentrated sulphuric acid. Conventionally, tantalum (Ta) metal was used as in very severe corrosive conditions such as a boiling concentrated sulphuric acid solution. However, because tantalum metal has low strength, especially under high temperatures, tantalum metal is not suitable for an apparatus and a structural material which require high strength. The highly corrosion-resistant molybdenum-based composite material which was previously developed by the present inventors as an alternative to tantalum metal had a disadvantage in that a base material is recrystallized during

the manufacturing process to cause the embrittlement of the entire material. (Specification page 2, line 18 to page 4, line 2).

Accordingly, it is an object of the present invention to provide an innovative material, which has sufficient high corrosion resistance and high strength in very severe corrosive conditions, for example, a boiling concentrated sulphuric acid (H_2SO_4) aqueous solution, in addition to high strength at high temperatures and high toughness at low temperatures. These are properties which could not be achieved with conventional materials. (Specification page 4, lines 3-11).

The inventors found that a worked molybdenum-alloy material having excellent corrosion resistance against oxidizing acids in addition to high strength and high toughness was effectively and inexpensively produced by subjecting a worked molybdenum material to a combination treatment of internal nitriding and external nitriding. The molybdenum nitride layer at the surface of the worked molybdenum-alloy material subjected to nitriding is composed of at least any one of δ-MoN, γ-Mo_2N, and β-Mo_2N. (Specification page 4, line 12 to page 5, line 11).

Claim 1 is directed to a worked molybdenum-alloy material such as illustrated in Figs 1, wherein the inside of the worked structure is recrystallized. The worked molybdenum-alloy material includes (1) a recrystallized structure inside the worked molybdenum-alloy material, (2) a nitride-particle-dispersed layer on the recrystallized structure, and (3) a molybdenum nitride layer on the nitride-particle-dispersed layer. The nitride-particle-dispersed layer (2) on the recrystallized structure is formed by internal nitriding of a nitride-forming-metal element dissolved in a molybdenum matrix in an untreated worked molybdenum-alloy material, whereby

and fine nitride particles are dispersed in a worked structure or recovered structure remained on the recrystallized structure. The molybdenum nitride layer (3) has a thickness of 3 μm or less, and it includes one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N. The molybdenum nitride layer (3) is formed by external nitriding of a worked structure or a recovered structure at the surface of the untreated worked molybdenum-alloy material. The worked molybdenum-alloy material subjected to the combination treatment of internal nitriding and external nitriding has a yield strength higher than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer when the molybdenum nitride layer (3) has a thickness on 3 μm or less. (Specification page 4, line 12 to page 5, line 20, page 7, lines 7-16, and page 8, line 5 to page 11, line 8).

Claim 7 is directed to a worked molybdenum-alloy material such as also illustrated in Fig. 1, but the inside of the worked structure is **not** recrystallized when the worked material is relatively thin. According to claim 7, a worked molybdenum-alloy material includes (1') a worked structure remained without recrystallization inside the worked molybdenum-alloy material, (2) a nitride-particle-dispersed layer on the worked structure, and (3) a molybdenum nitride layer with a thickness of 3 μm or less. The nitride-particle-dispersed layer (2) is formed by internal nitriding of a nitride-forming-metal element dissolved in a molybdenum matrix in an untreated worked molybdenum-alloy material. The fine nitride particles are dispersed in a worked structure or recovered structure on the worked structure. The molybdenum nitride layer (3) includes one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N. The molybdenum nitride layer is formed by external nitriding of a worked structure or a recovered structure at the surface

of the untreated worked molybdenum-alloy material. The worked molybdenum-alloy material subjected to the combination treatment of internal nitriding and external nitriding has a yield strength higher than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer when the molybdenum nitride layer (3) has a thickness on 3 μm or less. (Specification page 7, lines 16-21).

(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether Claims 1 and 7 are obvious under 35 USC §103(a) over WO 01/18276 A1 in view of JP 11-286770 A.

(VII) ARGUMENT

1. It Was Not Known That A Thin Mo Nitride Surface Layer Would Contribute To The Yield Strength In A Practical Manner.

The Examiner alleged in the Office Action dated 01/05/2009 as follows:

> It would have been obvious to one of ordinary skill in the art at the time the invention was made to form a Mo nitride layer at the surface of the worked Mo alloy material of Takada et al. ('368) as disclosed by JP ('770 A) in order to improve the corrosion resistance and the mechanical strength of the worked Mo alloy material of Takada et al. ('368) as disclosed by JP ('770 A) (abstract and paragraph [0006], machine translation). The yield strength of the worked Mo alloy material with the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A) would be **inherently higher** than that of the worked Mo alloy material without the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A).

(Office Action dated 01/05/2009, page 3, line 16 to page 4, line 3). The Examiner further alleged in the Office Action dated 05/12/2009 as follows:

> First, the applicant argues that the examiner applies inherency to a combination of prior art. In response, the examiner notes as stated clearly in the Office action dated January 5, 2009, Claims 1 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over WO 01118276 A1 in view of JP 11-286770 A. The rejection was not under 35 U.S.C. 102/103 as asserted by the applicant. The combination of the prior references as the ground of rejection is believed to be proper and is maintained. The yield strength of the worked Mo alloy material with the Mo nitride surface layer of Takada et al. ('368) in view of JP ('770 A) would be expected by one of skill in the art to be higher than that of the worked Mo alloy material without the Mo nitride surface layer because the Abstract of JP ('770 A) discloses that a Mo nitride surface layer formed by a nitriding treatment would increase the mechanical strength and hardness of a Mo based alloy.

(Office Action dated 05/12/2009, page 3, lines 1-12). Thus, the Examiner maintained that the rejection is under 35 U.S.C. 103(a). However, despite the Examiner's allegation, nothing in JP ('770 A) indicates that a Mo nitride surface layer formed by a nitriding treatment would increase the mechanical strength and hardness of a Mo based alloy. It is clear that the Examiner's allegation is based on the previously alleged basis that the yield strength of the worked Mo alloy material with the Mo nitride surface layer would be **inherently higher** than that of the worked Mo alloy material without the Mo nitride surface layer of Takada et al. ('368). However, it was not known to a person of ordinary skill in the art that a thin Mo nitride surface layer would contribute to the yield strength in a practical manner. The Examiner's allegation of inherency in the obviousness rejection under 35 U.S.C. 103(a) does not accord to the USPTO practice. Regarding inherency, the MPEP explains as follows:

IV. EXAMINER MUST PROVIDE RATIONALE OR EVIDENCE TENDING TO SHOW INHERENCY

> The fact that a certain result or characteristic **may occur** or be present in the prior art **is not sufficient to establish the inherency** of that result or characteristic. *In re Rijckaert*, 9 F.3d 1531, 1534, 28 USPQ2d 1955, 1957 (Fed. Cir. 1993) (**reversed rejection because inherency was based on what would result** due to optimization of conditions, **not what was necessarily present in the prior art**); *In re Oelrich*, 666 F.2d 578, 581-82, 212 USPQ 323, 326 (CCPA 1981). "To establish inherency, the extrinsic evidence 'must make clear that the missing descriptive matter is **necessarily present in the thing described in the reference**, and that it would be so recognized by persons of ordinary skill. **Inherency, however, may not be established by probabilities or possibilities**. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.' " *In re Robertson*, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-51 (Fed. Cir. 1999) (citations omitted) . . . .

(MPEP 2112). Thus, inherency applies only when the characteristic is necessarily present in the prior art even though the prior art is silent as to the inherent characteristic. Neither product disclosed in Takada et al. ('368) nor in JP ('770 A) appears to be identical to the presently claimed material. The Examiner himself recognizes the difference and, therefore, alleges obviousness based on the combination of Takada et al. ('368) and JP ('770 A). Also, the Examiner admits that Takada et al. ('368) does not disclose that the worked Mo alloy material comprises a Mo nitride layer at the surface of the worked Mo alloy material as claimed. Also, JP ('770 A) has been only cited for allegedly disclosing a Mo alloy with a Mo nitride layer having a thickness of 0.5 to 10 microns at the surface and the Mo nitride at the surface comprising gamma-Mo_2N, beta-Mo_2N and delta-MoN. **The Examiner's alleged inherency is imaginary, but is not necessarily present in the prior art.**

It is well established that, even if a combination appears to be obvious, the combination still can be patentable where there is significant unexpected result. If inherency is applicable against a combination of prior art references, even such unexpected results would be inherent in the imaginary combination. Thus, the rejection based on application of inherency to an imaginary combination of prior art references is in appropriate.

2. Prima Facie Case Of Obviousness Is Rebutted Based On The Description In The Present Specification.

Even assuming, *arguendo,* that it is *prima facie* obvioous to form a Mo nitride layer on the surface of the worked Mo alloy material, the prima facie case of obviousness is rebutted based on the description in the present specification. The translation of JP ('770 A) describes on the thickness of the Mo nitride layer as follows:

> In said invention, if nitriding temperature exceeds less than 700°C or 1150°C, an outstanding Mo_2N layer of the target corrosion resistance will not be made. When Mo_2N layer thickness is less than 0.5 micrometer, or also when exceeding 10 micrometers, it is difficult to acquire corrosion resistance made into the purpose of this invention.

(JP ('770 A), paragraph [0009]). Thus, JP ('770 A) simply indicates that Mo_2N layer thickness between 0.5 micrometer and 10 micrometers is preferable for the purpose of corrosion resistance. Nothing in JP (770 A) indicates that the Mo_2N layer improves the strength of the molybdenum-alloy material, especially internally nitrided worked molybdenum-alloy material.

In contrast, the present specification, Table 1 at page 11, shows the relationship between the temperature of heating treatment and the thickness of the surface layer of a Mo-Ti-alloy. The thickness of molybdenum nitride increases with the heated temperature. If a Mo nitride layer is

formed on the surface of the worked Mo alloy material solely to improve corrosion resistance, it would be preferable to increase the layer thickness in view of corrosion resistance. However, the present inventors found that toughness was reduced with the increase in layer thickness. Also, the present inventors found that thickness of molybdenum nitride layer should be 3 μm or less.

(Table 1)

	Pure Mo	Material subjected to internal nitriding up to third step	(Internal nitriding up to third step) + (external nitriding) (2.8 μm)
Yield strength	550 MPa	1190 MPa	1280 MPa
Maximum strength	750 MPa	1620 MPa	1870 MPa

Thus, Takada et al. and JP ('770A) does not teach or suggest, among other things, "a molybdenum nitride layer on the nitride-particle-dispersed layer, the molybdenum nitride layer having a thickness of 3 μm or less, the molybdenum nitride layer comprising one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N, the molybdenum nitride layer being formed by external nitriding of a worked structure or a recovered structure at the surface of the untreated worked molybdenum-alloy material, wherein the worked molybdenum-alloy material has a higher yield strength than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer," as recited in claim 1.

Also, Takada et al. and JP ('770A) does not teach or suggest, among other things, "a molybdenum nitride layer with a thickness of 3 μm or less, the molybdenum nitride layer comprising one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N, the molybdenum nitride layer being formed by external nitriding of a worked structure or a recovered structure at the surface of the untreated worked molybdenum-alloy material, wherein the worked molybdenum-

alloy material has a higher yield strength than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer."

The Examiner further alleged as follows:

> Second, the applicant argues that the instant invention shows unexpected results compared with Takada et al. ('368) in terms of yield and maximum strengths. In response, the examiner notes that **there is no yield strength and/or maximum strength values recited in the instant claims 1 and 7**; and that the applicant has not compared the unexpected results from the instant invention with those from the prior art.

(Office Action, page 3, lines 13-17). It appears that the Examiner alleges that Applicant should not allege unexpected results unless the unexpected results are recited in the claim. However, claim is not supposed to recite such results. Claims directed to a product are supposed to recite the structural features or material features. Results and advantages of the invention would be ordinarily no more limiting than the purpose or intended use of the invention.

The present invention shows unexpected results compared with Takada et al. ('368). There is no reasonable basis that improvement of the strength of the material is expected. As shown in Table 1 in the present specification, both yield strength and maximum strength are significantly improved by the external nitriding. It was not expected for a person having ordinary skill in the art that there is correlationship between the yield strength of the Mo alloy worked material and the thickness of the thin molybdenum nitride surface layer formed on the Mo alloy.

The thickness of molybdenum nitride increases with the heated temperature. It would be preferable to increase the layer thickness in view of corrosion resistance. However, the present

inventors found that toughness was reduced with the increase in the layer thickness. Also, the present inventors found that thickness of molybdenum nitride layer should be 3 μm or less.

Moreover, as shown in Fig. 3, the worked material of the present invention exhibits high corrosion resistance. Also, the disclosure of the present application describes that a worked molybdenum-alloy material subjected to nitriding of the present invention had very high strength in addition to high corrosion resistance.

For at least these reasons, claims 1 and 7 patentably distinguish over Takada et al. ('368) and JP ('770A).

(VIII) CONCLUSION

For the foregoing reasons, the Examiner has failed to establish a prima facie case of obviousness or erred in evaluating the significance of the present invention in the rejection of claims 1 and 7. The Honorable Board is respectfully requested to reverse the rejection of the Examiner.

If this paper is not timely filed, appellants hereby petition for an appropriate extension of time. The fee for any such extension may be charged to Deposit Account No. 50-2866, along with any other additional fees that may be required with respect to this paper.

Respectfully submitted,

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(IX) CLAIMS APPENDIX

1. (Rejected): A worked molybdenum-alloy material having high corrosion resistance, high strength, and high toughness, comprising:

a recrystallized structure inside the worked molybdenum-alloy material;

a nitride-particle-dispersed layer on the recrystallized structure, formed by internal nitriding of a nitride-forming-metal element dissolved in a molybdenum matrix in an untreated worked molybdenum-alloy material, fine nitride particles being dispersed in a worked structure or recovered structure on the recrystallized structure; and

a molybdenum nitride layer on the nitride-particle-dispersed layer, the molybdenum nitride layer having a thickness of 3 μm or less, the molybdenum nitride layer comprising one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N, the molybdenum nitride layer being formed by external nitriding of a worked structure or a recovered structure at the surface of the untreated worked molybdenum-alloy material,

wherein the worked molybdenum-alloy material has a higher yield strength than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer.

2-4. (Cancelled).

5. (Withdrawn): A method for manufacturing a worked molybdenum-alloy material,

comprising the steps of:

internally nitriding_an untreated worked molybdenum-alloy material in which at least any one of titanium, zirconium, hafnium, vanadium, niobium, and tantalum is dissolved to form a solid solution in a molybdenum matrix through a multi-step internal nitriding treatment including at least three-step increases of treatment temperature, and then

externally nitriding the worked alloy material through an external nitriding treatment at 900 °C or lower so as to form a molybdenum nitride layer of 3 μm or less,

wherein the worked molybdenum-alloy material has a higher yield strength than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer.

6. (Withdrawn): The method for manufacturing a worked molybdenum-alloy material subjected to nitriding according to Claim 5, wherein the internal nitriding treatment is performed with a nitrogen gas, and then the external nitriding treatment is performed with an ammonia gas.

7. (Rejected): A worked molybdenum-alloy material with high corrosion resistance, high strength, and high toughness, comprising:

a worked structure without recrystallization inside the worked molybdenum-alloy material;

a nitride-particle-dispersed layer, on the recrystallized structure, formed by internal nitriding of a nitride-forming-metal element dissolved in a molybdenum matrix in an untreated

worked molybdenum-alloy material, fine nitride particles being dispersed in a worked structure or recovered structure on the recrystallized structure; and

a molybdenum nitride layer with a thickness of 3 μm or less, the molybdenum nitride layer comprising one or more selected from δ-MoN, γ-Mo_2N, and β-Mo_2N, the molybdenum nitride layer being formed by external nitriding of a worked structure or a recovered structure at the surface of the untreated worked molybdenum-alloy material,

wherein the worked molybdenum-alloy material has a higher yield strength than the worked molybdenum-alloy material without the molybdenum nitride layer on the nitride-particle-dispersed layer.

(X) EVIDENCE APPENDIX

None Presented.

(XI) RELATED PROCEEDINGS APPENDIX

No related proceedings.